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THEOLOGICAL, HISTORICAL, METAPHYSICAL AND POLITICO-ECONOMICAL SUBJECTS.

By James Napier Bailey.

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Sketches of early English Scientific Authors continued 63.

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TO THE READER.

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rum disciplinarum."* that is, the emporium of the best scholars or philosophers.

As Paris was the resort of all who aspired to literary and philosophical distinction during the thirteenth century, Bacon went thither to attend the lectures delivered in the Parisian University, and to pursue his scientific and grammatical studies. He soon distinguished himself at Paris by his uncommon proficiency in all the branches of learning that were cultivated at that time, and obtained, a little after his arrival, the degree of Doctor. This was subsequently confirmed by the University of Oxford. Shortly afterwards he took the vows of a Franciscan, in a convent belonging to that order of Friars at Oxford, in order that he might be enabled to pursue his studies without molestation. The vow of the Franciscans was poverty, manual toil, and study; but the two former were avoided as carefully as possible by the holy friars. Bacon, however, applied himself with great diligence to the study of Medicine, Jurisprudence, the Oriental and Western Languages, and several branches of Natural Philosophy. He explored, with indefatigable industry, the mines of Grecian and Arabian learning, and conducted various researches into the properties of natural bodies with signal success. He informs us, in one of his works, that he had laboured in his youth to acquire a knowledge of sciences and languages, and that by this means he had been enabled to collect and digest many useful things. He states that he had sought the friendship of all wise men among the Latins, and had caused young men to be instructed in languages, figures, tables, numbers, instruments, and many other useful matters. He informs us further, that "he had examined all things necessary to the improvement of his studies, and knew with what helps to proceed, and what also were impediments, but that he could not obtain the assistance he needed for want of pecuniary ability. Howbeit, if any one would undertake these things which he had proposed, he had little doubt of their accomplishment."†

Bacon was well acquainted with the Latin, Greek, and Hebrew Languages; and, according to Wood, wrote a grammar, of these tongues.‡ It may be inferred from many passages in his writings that he was well versed in the works of several

* 2 Balæus cent. 3 nu. 74. Wood. Antiq. Oxf. vol. i. b. 1. p. 196, Edit. Gutch.

† In Oper. Minor. cap. 17. and in Oper. Tertio. ad Clem. IV. as quoted by Wood. Hist. Antiq. Oxf. vol. i. b. 1. p. 332.

‡ Hist. Antiq. Oxf. vol. 1, b. 1. p. 339. Edit. Gutch.

Greek and Arabian physicians.* He did not pay much regard to the authority of Aristotle, which was highly venerated in the schools of Europe, about the time Bacon addressed his "Opus Majus" to Clement IV. On the contrary, he freely criticised the writings of the Stagirite, and especially the translations of his works, which were then made use of in the schools. These, he affirms, were so wretched that the time and labour employed in reading them were lost, and that if he could have procured all the Latin translations of Aristotle's works he would have committed them to the flames as the fertile source of ignorance and error. At another place, when speaking of the veneration paid to the writings of Aristotle, he observes :—"He is preferred before all other philosophers by the learned; whatever he has affirmed is received by them as true and sound philosophy; and, in a word, he is regarded as an authority in philosophy, in the same way as Paul is in divinity." Considering the heretic-hunting, book-destroying age in which Bacon lived, he had too noble and lofty a spirit to stoop to any authority in science, except that of reason and investigation.

Despising, to a great extent, the scholastic logic, as well as the "*sublime*, *profound*, *wonderful*, *seraphic*, and *angelic-Doctors*" of his day, he laboured, both by his example and writings, to turn the inquiries of his contemporaries into the path of experiment which, he endeavoured to show was more convincing than abstract reasoning. To illustrate this, he adduces the following example :—"Though it were proved by sufficient arguments to a man who had never seen fire before, that it consumed and destroyed all things that were put into it, he would not be fully convinced of this truth by any arguments, till he had put his hand, or some combustible thing, into the fire; which experiment would at once remove all

* It is unnecessary to particularize the Greek physicians, because they are known to almost every school boy. The Arabian physicians, with whose writings Bacon was most familiar, were the following:—Isaac Beimiram, the son of Soloman the physician, who flourished about the year 1070. *Hali-Abbas*, whose treatise *de Regali Dispositione* in twenty books, was translated by Stephen his scholar, at Antioch, out of Arabic into Latin, A.D. 1127. Avicenna or AL SHEIKH AL RAYIS ABU ALI AL HOSSEIN BEN ABDALLA BEN SINA, a learned physician whose name ruled the world of science for a longer period than any other, with the exception of Galen and Aristotle. Averroes, who flourished about the year 1149. Rasis, sometimes called Almansor, and Johannes Damascenus, the latter of whom flourished about 1158.—*Vid. Life of Bacon, prefixed to the translation of his "Cure of Old Age," by Richard Browne, M.L. Coll. Med., Lond. published in* 1683.

doubt and bring full conviction." This passage would almost indicate that Bacon had anticipated the mighty reform subsequently effected in philosophy by his namesake, the great author of the "Novum Organum."

Bacon was eminently skilled in mechanics, statics and optics as they were known in his day. He constructed many burning glasses after the example of Archimedes. The first of these cost him sixty pounds Parisian money, equal, at that time, to about twenty pounds sterling, and, in the present age, to one hundred and eighty seven pounds. He afterwards became more expert in constructing these instruments, and discovered that better ones might be made for two marks, nay, for twenty shillings, or even less. In the construction of these latter, he informs us that great attention and dexterity were required.* He says that he had expended in *chemistry, experimental, perspective,* and practical astronomy, in the course of twenty years, no less than £2000; a sum equal to £18,733 of the present currency. It is difficult to ascertain the mode in which he procured such large sums of money; but it is exceedingly probable that he obtained assistance from such men as Bishop Grostêst, who admired his genius, and encouraged him to proceed in his endeavours to improve philosophy.

Bacon complains, in several parts of his writings, of the charge of his experiments, the sequestration of his books, and the hard usage he had received from the bigots of his order. He informs Pope Clement IV., to whom he addressed his "Opus Majus," that is "the greater work," that some of his experiments, especially that of burning things at a distance, would cost at least one thousand marks.†

At another place, speaking of certain mathematical instruments, he says they could not be made for less than two hundred or three hundred pounds.‡ These were large sums of money in Bacon's day.

He also complains bitterly of the manner in which geometry and other branches of mathematical learning were neglected in his day. "The neglect of mathematics," he observes, "for these thirty or forty years past, has done great injury to learn-

* MSS. in Cott. Lib., quoted by Dr. Jebb. Præfat Opus Majus p. 9 Note.

† His words are :—Et certe combustio in omni distantia constaret plus quam mille marcus ante quam specula sufficientia fierent ad hoc. —*In Oper. Min. MSS. Bibl. Bodl.. as quoted by Dr. Plot. Nat. Hist. Oxf. chap.* 9. *sec.* 6. *p.* 217. *Fol.* 1677

‡ Instrumenta hæc non sunt facta apud latinos, nec fierent pro ducentis nec tricentis libris.—*In Oper. Minor., Part* 3, *cap.* 11, *as quoted by Plot. ut supra.*

ing among the Latins."* This neglect was so great, he affirms, "that very few students proceeded further in their mathematical studies than to the fifth proposition in Euclid's Elements, and that there were not more than five or six persons then living who had made any great proficiency in mathematical knowledge."† "The truth is," says Henry, "that mathematical studies, in those times, brought neither honour nor profit to those who engaged in them. On the contrary, those few who prosecuted them with ardour and success, were strongly suspected of holding a criminal correspondence with infernal spirits, and, on that account, were hated and persecuted as magicians."‡

Bacon laboured with great diligence and laudable zeal to exhibit the importance of arithmetical studies. "A theologian," he observes "should excel in the knowledge of numbers, and be able to understand all arithmetical operations, namely, numeration, addition, subtraction, mediation, multiplication, division, and extraction of the roots, as it regards both integers and fractions. He must not only understand vulgar fractions as halfs, thirds, fourths, fifths, &c., but he must also be acquainted with the mode of computing astronomical fractions, as minutes, seconds, thirds, fourths, fifths, &c.; as in chronological calculations, he must refer to the motions of the sun and moon, in which case such fractions are of prime importance. He must be able to understand the fractions of the Latins and Arabians, as well as those of the Hebrews who divide the hour into one thousand and eighty parts. It is necessary also that he should understand the reduction of fractions of divers denominations into those of one kind; for fractions of different kinds, as seven-fifths, ten-sevenths, two-eighths, occur among integers: and he will not be able to manage these numbers properly, unless he understands the method of reducing these different fractions into one kind of fraction, and by this means into integers."§ This passage enables us to form a conjecture respecting the extent of Bacon's arithmetical acquirements, and the condition of the arithmetical art during the thirteenth century.

Of the state of Astronomical science in Bacon's day, and of the amount of his knowledge respecting it, he gives us the following information in his "Opus Majus." I use Henry's translation, having compared it with the original, and ascer-

* Cujus negligentia jam per triginta vel quadragintia annos destruxit totum studium Latinorum.—*Opus Majus, p.* 57.

† Opus Majus, p. 428, as quoted by Henry. Hist. Great Brit. vol. 4, b. 4. sec. 1, p, 415.

‡ Henry, ut supra. § Opus Majus, p. 138.

tained its correctness. Bacon observes :—"Astronomy is the study of the heavenly bodies, by which their dimensions, distances, motions, &c., are investigated. It is either speculative or practical. Speculative astronomy ascertains the number of the heavens and stars, whose dimensions can be comprehended by instruments, and discovers their figures, magnitudes, altitudes, densities, risings, settings, and motions, together with all the varieties and degrees of their eclipses. It even condescends to speculate concerning the figure and dimensions of this earth which we inhabit, and of its larger divisions which are called climates ; and shews the diversity of the horizons, and of days and nights in each of these climates. By speculative astronomy, all these things and many others are determined. *Practical Astronomy* teaches us to discover the places, aspects, influences, and changes of the stars and planets at any particular time. It attends also to those bodies which occasionally appear in the air, as comets and rainbows, in order to discover their places, altitudes, magnitudes, figures, and many other things which it is necessary to know. These things are done by proper instruments, by astronomical tables, and by certain rules and canons, invented for that purpose. All these investigations are intended to enable the astronomer to pronounce a judgement on what things can be done by the power of philosophy, not only on matter but on all things connected with matter, when guided by the influence of the heavenly hodies. They are also intended to enable us to pronounce a judgement *on future events, as well as on those that are past and present;* and to advance wonderful works for promoting the prosperity and preventing the misery of mankind, and that too in the most illustrious and beneficent manner."*

The preceding extract shows at once the strength and the weakness of Bacon's intellect. What he terms the "*Practical part of Astronomy*" is obviously the vain and fallacious art of predicting future events by the rules of *Judicial Astrology.* This absurd art was in high repute in Bacon's day, and it is evident from his writings that he was a great adept in it. So firmly was he convinced of its truth and importance that he attributed all the calamities and wars which afflicted Spain, Italy, England, and other countries in the year 1264, to the desuetude into which it had fallen. "O how happy would it have been for the Church of God," he exclaims, "and how many evils would it have prevented, if the aspects and influence of the heavenly bodies had been predicted by learned men and

* Opus Majus, p. 65.

known to the princes and prelates of those times! There would not then have been so great a slaughter of the christian world, nor would so many miserable souls have been sent to hell."* It should be remembered, however, that this was more the foible of the age than of the man, and that the cultivation of the fallacious art of astrology tended to improve the more noble and truthful science of physical astronomy.

In the days of Bacon, both astrology, the hermetic art, and many other follies, were in high repute in the philosophical world. Prior to the sixteenth century, the magnet was commonly believed to have the power of curing many diseases, and of enabling an individual to detect the matrimonial infidelity of his wife.† Bacon did not escape the prevailing superstition of his age. His astrology, however, is physical. "With respect to human affairs," he observes, "true mathematicians do not presume to make certain, but

* O quanta utilitas ecclesiæ Dei potuisset procurari, si cœli qualitas istorum temporum fuisset prævisa a sapientibus, & prælatis & principibus cognita & pacis studio mancipata. Nam non fuisset tanta christianorum strages, nec tot animæ positæ in infernum. Opus Majus. p. 243.

† This foolish and ridiculous notion continues to be cherished by some minds even in the present day. The author of this work is acquainted with a person who, having once received a slight shock from a small electrifying machine, was afflicted with a violent toothache some time afterwards. As a certain degree of sequency was observable between the reception of the shock and the sensation of pain which followed, the person in question attributed the latter to the former. Upon stating the case to a physician, and requiring his assistance, he gravely prescribed that his patient should keep rubbing the face with a magnet, in order, as he sapiently observed, "to draw the electricity out of it." This gentleman deserves to have a long array of cabalistic initials, as F. R. S., *A. S. S.* attached to his name, and to be knighted by our sovereign lady the Queen, for the services he has rendered to medicine. A learned, though unpretending writer in the *Magazine of Popular Science*, gives the following extract relative to the subject mentioned in the text, from a manuscript of the fourteenth century, in his possession :—"If a man wyl prove hys wyfe or hys leman of truthe put yis ston under her hed whan che is on slepe, and if che be trewe che wyl turn to hymward ; and if che be nought trewe, che wyl styrt awayward as a beste yat is a flayed." —*Mag. Pop. Science, vol* 4, *p.* 272, *note.*

The same thing occurs, in a manuscript on precious stones, in the British Museum :—"Magnes est lapis Jordane inventus ferrei coloris et ad se trahens ferrum cum quo Marita probant uxores suas. Sic ponitus super caput dormientis ; si casta est super faciem suam vertet ; si adultera supina Jacebit."—*Arund. MSS., N.* 342, *fol.* 76. The sense of this is the same as the foregoing.

endeavour to ascertain how the body is altered by celestial influences ; and the body being altered, the mind is excited, both to acts of a private and public nature, free-will existing all the same." The present age can require nothing more from a philosopher of the thirteenth century, respecting a doctrine which was commonly believed at that time, and the truthfulness of which was admitted, though its tendency was condemned by the Christian Church. When we see men in the present age of enlightenment crediting the revelations of Miss Southcote, or building up a system of faith, on certain miracles, said by ignorant fishermen to have been performed eighteen centuries ago, we need not wonder at Bacon being a believer in astrology. Perhaps the Franciscan philosopher was prejudiced in favour of the *judicial art*, because both it and the mathematical sciences were regarded as necromantic by the ecclesiastical bigots of his day. If Newton and La-Place had lived in the thirteenth century, they would probably have been believers in astrology as well as Bacon.

Bacon's knowledge of mechanical powers and their varied combinations, was so extensive, and appeared so extraordinary to the barbarous monks and stupid populace, that they considered him as a magician who had dealings with the devil. To remove that suspicion, he wrote his celebrated epistle concerning the miracles of art and nature, and the nullity of magic. In that work he reprobates the use of magical characters and incantations, and affirms that more wonderful things may be performed by the combined powers of Art and Nature, than were ever supposed to result from the operations of magic. "I will now," he observes, "allude to some of the extraordinary works of Art and Nature which magic could not perform, and with which it is not connected. Instruments may be made, by which the largest ships, with only one man guiding them, will be carried with greater velocity than if they were full of sailors ; chariots may be constructed that will move with amazing rapidity, without being drawn by animals ; and instruments of flying may be constructed by which a man, sitting at his ease and pondering on any subject, may navigate the air, after the manner of birds." He says also, "that an instrument may be fabricated which shall enable one man to draw a thousand of other men towards him by force and against their inclinations ; and that it is possible to make machines which will enable men to walk at the bottom of seas or rivers without danger." What is still more remarkable, he affirms, that all those instruments were made in his day, that he had seen them all, with the exception of that for flying, which he had never seen, though he was well acquainted with the wise man who had invented it.

Notwithstanding the positiveness of Bacon's affirmation, "that he had seen those machines," I almost doubt its accuracy. From his knowledge of mechanics, it may be supposed that he conjectured the possibility of constructing the machines he mentions. Nay, he may have even constructed working models of such machines which would justify him in stating that he had seen them. All this is probable; but that such machines were in general use, and on a large scale, during the thirteenth century, is a statement not sufficiently supported by historical testimony.

The mathematical and astronomical knowledge of Bacon appeared in his discovery of the error which occasioned the Gregorian reformation of the calendar, and in his attempt to square the circle. He proposed an emendation of the Julian Calendar to Pope Clement IV. His arguments were afterwards employed by Paul of Middleburgh, who was Bishop of Fossombrona in Italy, in order to convince Pope Leo X of the necessity for such a reform. This Paul, in his huge and unwieldy volume, "On the Rectification of the Date of the Passover, and of the day on which the Passion of Christ is celebrated," borrows the greater part of his arguments from Bacon's lucubrations, without any kind of acknowledgment.* The Calendar was subsequently rectified by the Polish astronomer, Copernicus, for the Council of Trent, A. D. 1581.

The "Opus Majus" of Bacon, shows that he had not only made considerable progress in mathematical learning, but had also acquired a considerable degree of knowledge respecting descriptive geography, as far as it was known in his day. Many circumstances concurred to increase his knowledge of the inhabitants of the globe, and of the various countries upon its surface. About the year 1246, two embassies were despatched by Pope Innocent IV. to the Mongolian Princes, or Tartars, as they were then termed in Christendom, one of which was under the direction of Ascelin and some other Franciscan monks, the superintendence of the other embassy being entrusted to Father John de Plano Carpini a Minorite Friar. Seven years afterwards, Lewis IX., King of France, sent a friar, named William, into Tartary, for the purpose of exploring the country, and reporting on its condition. The accounts which these individuals gave upon their return to Europe of the strange countries through which they had passed, fell into the hands of Bacon;† and from these and other sources, he composed a description of all the countries

* Wood Hist. Antiq., Oxf., vol. 1, b. 1, p. 341, edit. Gutch.

† He alludes to them in several parts of the "Opus Majus." vid. pp. 190, 191, 233.

of Europe, Asia, and Africa, that were known in the thirteenth century. That description is long and curious; and though frequently based on the writings of Ptolemy and Pliny, contains many new facts from the travellers already mentioned, and others. Considering the age in which it was written, it reflects great credit on the sagacity of its author.

It appears that Bacon had adorned that part of the "Opus Majus" which treats of descriptive geography, with a map, in which the latitude and longitude were marked by meridian and parallel lines, as in the maps of the present day.* "But unfortunately," says Henry, "this map is not to be found in any of the copies of our author's "Opus Majus" yet discovered. It is still more remarkable that Bacon laboured with great earnestness to prove that a much greater proportion of our terraqueous globe was dry land and habitable, especially in the southern hemisphere, than was commonly believed; and that he endeavoured to prove this by the very same arguments which determined Columbus two centuries after to go in quest of the New World."†

The knowledge which Bacon possessed of optics and of the chemical composition of gunpowder, were two of the most prominent features in his character. It is reasonable to infer from several passages in his writings, that he understood the composition of gunpowder, and was aware of the terrible effects it is capable of producing. These he has minutely described in his works. The following passage places this almost beyond a doubt:—

"Some things disturb the ear so much, that if they were made to happen by night, and with sufficient skill, no city or army could bear them—no noise of thunder could compare with them. Some things strike terror on the sight, so that *corruscationes nubium* the flashes of the clouds are beyond comparison less disturbing; works similar to which Gideon is supposed to have performed in the camp of the Midianites. An example of this we draw from a childish amusement, which exists in many parts of the world, viz., that with an instrument as large as the human thumb, *by the violence of the salt called saltpetre*, so horrible a noise is made by the rupture of so slight a thing as a bit of parchment, that it is thought to exceed the loudest thunder, and *corruscationem maximam sui luminis jubar excedit*, the flash is stronger or more vivid than the brightest lightning."‡

In the last chapter of the treatise in which this celebrated passage occurs, he discovers the ingredients of which this

* Opus Majus, p. 186.

† Henry's Hist. Great Brit., vol. 4, Opus Majus, pp. 184. 185, et seq

‡ Opus Majus, p. 474.

composition is made. "By saltpetre, sulphur, and the powder of wood-coal," he observes, "you may make this thunder and corruscation if you understand the art of compounding them." It is true, that in the original, the letters which compose the words *carbonum pulvere, i. e.*, powder of wood-coal, are not placed in proper order, but this was done, as Dr. Dee conjectures, to conceal the knowledge of this dangerous mixture from unskilful persons, as well as from a benevolent desire to prevent the evil effects which might arise from an improper application of it.* Dr. Plot asserts, that a manuscript copy of Bacon, in the hands of Dr. G. Langbain, and which was seen by Dr. Wallis, explained the ingredients of which Bacon's detonating mixture was composed. These were stated to be sulphur and *carbonum pulvere*, or powder of wood-coal?† If Bacon really understood the composition of gunpowder, it is probable he was not the original discoverer of it, as Marcus Græcus, an author mentioned, according to Dr. Hutton, by an Arabian physician of the ninth century, gives the receipt for making gunpowder, namely, one part of sulphur, two of willow charcoal, and six of saltpetre. Sir George Staunton says the Indians and Chinese "have long possessed the art of making gunpowder, which they use for blasting rocks and making fireworks," though probably they never applied it to the propulsion of bodies from a tube, until taught to do so by the natives of Europe.‡

* De Secret Oper. Art. Nat. Annot. to cap. 6. By John Dee, Hamburgh.

† Plot. Nat. Hist., Oxfordshire, chap. 9, § 39, p. 233. Fol. Oxon. 1677.

‡ The following passage from one of Bacon's works exhibits the knowledge he had acquired respecting the chemical properties of bodies:—"We may have an artificial composition of saltpetre and other ingredients; or of the oil of red petrolei and other things; or with maltha naphtha, with such like, which will burn at what distance we please, with which Pliny reports (Lib. 2, c. 104) that he kept a city against the whole Roman army, for by casting down maltha he could burn a soldier though he had on his armour. Next to those we may place the Grecian fire and other combustibles. To proceed, lamps may be made to burn and water to keep hot perpetually. For I know many things that are not consumed in the fire, as the salamander's skin, Talk" (Talc) "with others, which by some adjunct are both inflamed and shine, yet are not consumed but are rather purified. As the making thunder and lightning in the air," &c. In the same chapter, speaking of the wonderful property of the loadstone by which it attracts iron, he says, "In this attraction of iron experience will show a diligent observer more wonders than any vulgar capacity can entertain."—*Discov. of Mirac. Art. Nat, Mag. cap.* 6, *Concerning strange Experiments, p.* 234. *Translation from Dr. Dee's own copy, by T. M. Lond.* 1659.